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HYDRAULIC RETRACTOR CONTROL

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2 Sheets-Sheet 1

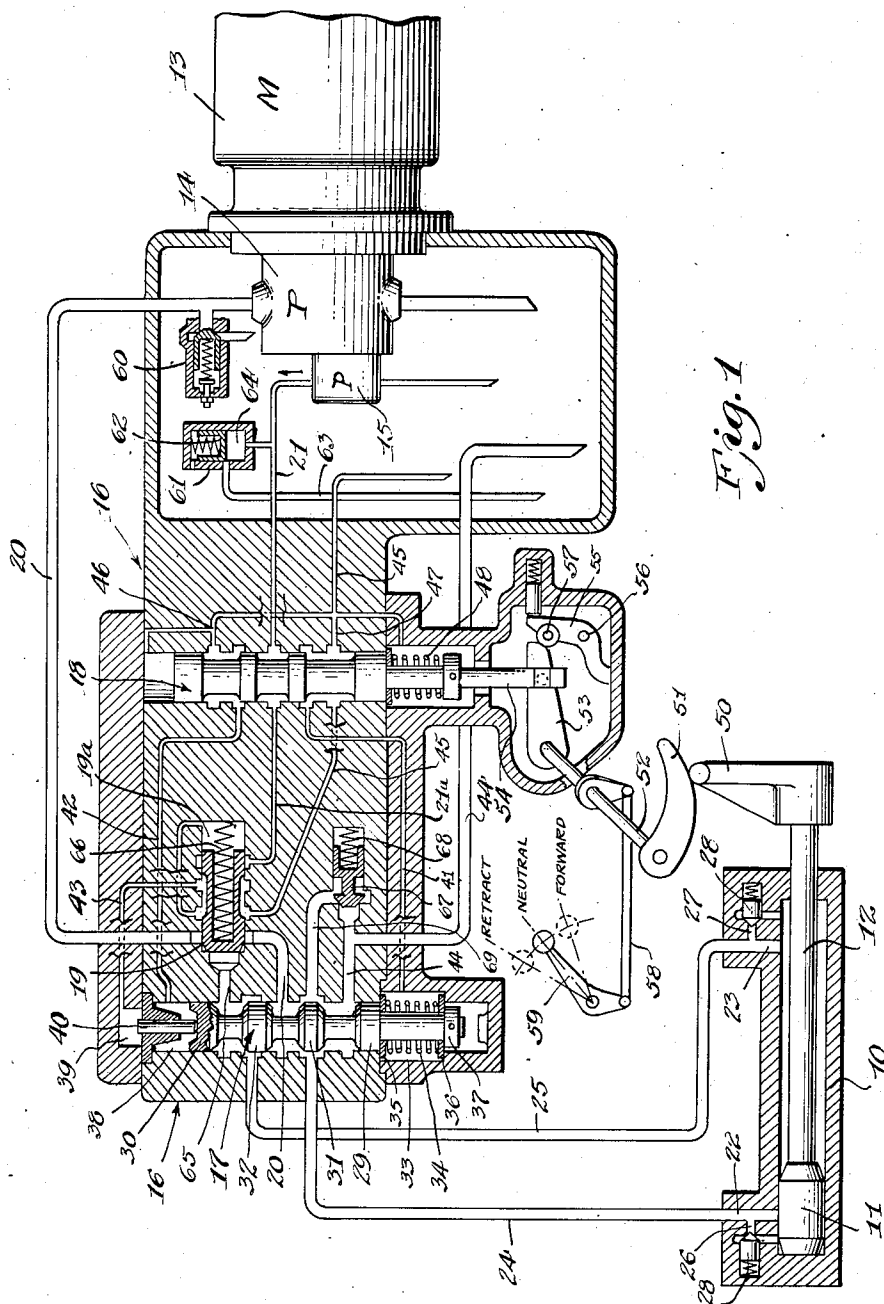


Fig. 1

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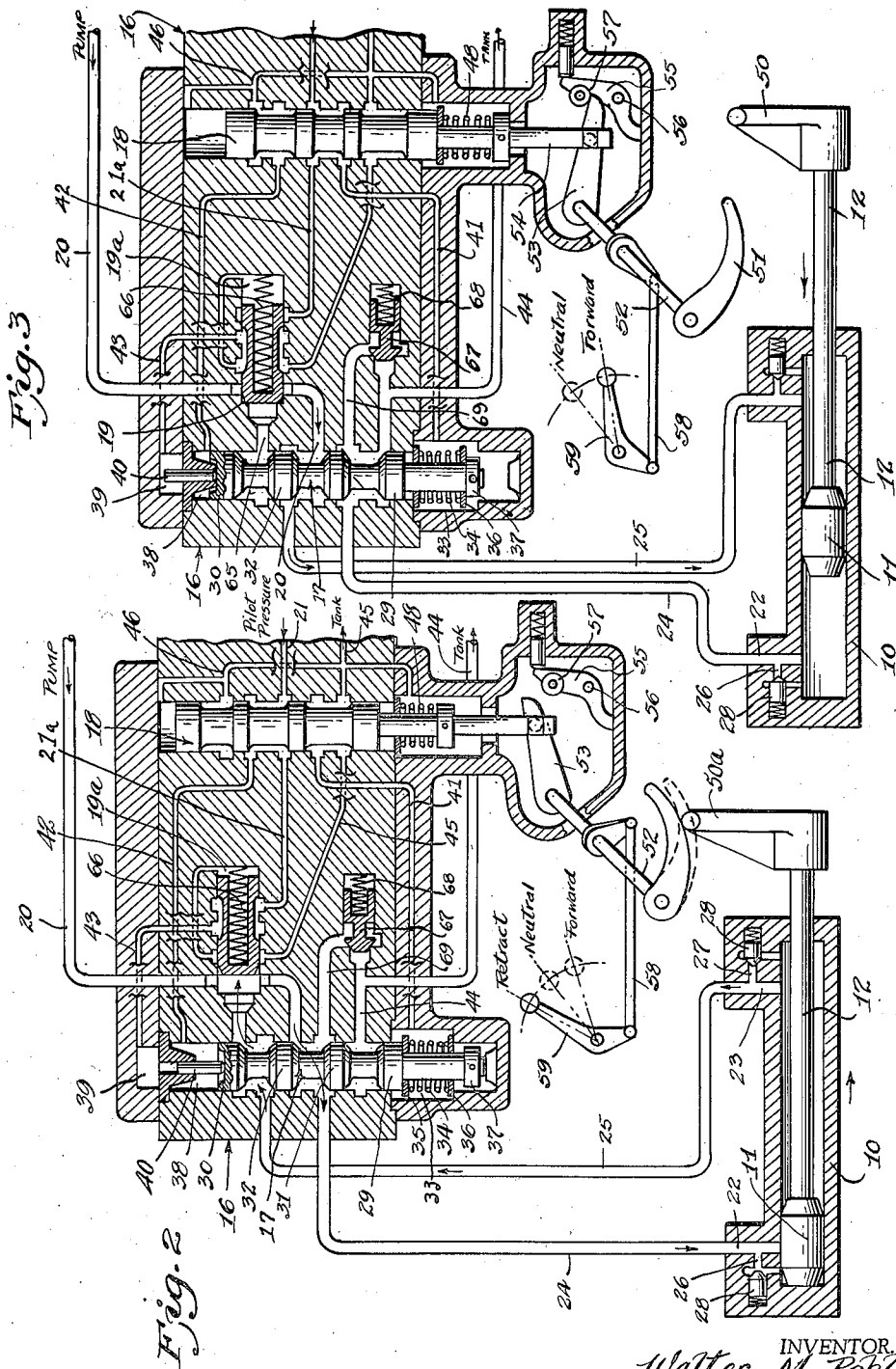
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HYDRAULIC RETRACTOR CONTROL

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13 Claims. (Cl. 60—52)

This invention relates to a hydraulic retractor control and has particularly to do with an improved control system for a hydraulic motor.

An object of the present invention is to provide a hydraulic control system in which a novel arrangement of valves permits the continued movement of a motor to be effected by slight movement of the motor by an external force in the particular direction concerned.

A further object of the invention is the provision of a system which may operate automatically but may be fully controlled by manual operation. The hydraulic control system concerned herewith is especially adapted to the rammer mechanism of large guns in which it is desirable to have the retraction movement initiated by gun recoil. It is also adapted to a wide variety of commercial apparatus such as conveying machinery and the closing and opening of doors on industrial furnaces.

Other objects and features of the invention relating to the details of the hydraulic circuit and the operation thereof will be brought out in the following description and claims.

In the drawings:

Fig. 1 is a circuit diagram mostly in section with each of the conduits being shown in a single plane for purposes of illustration.

Figs. 2 and 3 are views of portions of Fig. 1 showing the parts in different relative positions though a portion of Fig. 2 is modified from Fig. 1.

An illustration of the principles of the invention will now be described in connection with the drawings. A motor to be driven, consists of a cylinder 10 and a piston 11. A rod 12 extends from the motor through one end of the cylinder. A motor 13 drives a pump 14 which serves as a main pressure source and a pump 15 serves as a source of pilot pressure.

A valve block is shown at 16 and in this valve block are located a directional control valve 17 for controlling pressure from the main source. A directional control valve 18 controls pressure from the pilot source and an additional control valve 19 controls, simultaneously, pressure from said main source and said pilot source. A conduit 20 leads from the pressure source to valves 19 and 17 and a conduit 21 leads from the pilot source 15 to the directional control valve 18. The cylinder 10 is provided with ports 22 and 23 at each end thereof and these ports are connected respectively to conduits 24 and 25 leading from the valve 17. It will be seen that the ports 22 and 23 do not enter the cylinder at the extreme ends thereof. Additional passageways 26 and 27

lead to a point directly adjacent the ends of the cylinder and these passageways are each closed by a check valve 28.

The valve 17 consists of a spool which is located in a cylindrical recess in the housing 18, said spool having two end piston formations 29 and 30 and two central pistons 31 and 32. The lower end of the valve 17 extends into a chamber 33 and is surrounded by a spring 34 which bears against washers 35 and 36. Movement of these washers on the valve is limited in one direction respectively by the piston formation 29 on the one end and a collar 37 at the lower end. The washers have a loose fit on the valve so that pressure may pass around them, as in the case of washer 36, to the chamber directly below the valve. When the valve is in neutral position, as shown in Fig. 1, each of these washers bears on a shoulder in the valve housing and it will thus be seen that the spring 34 tends to maintain the valve 17 in its neutral position. Above the piston formation 30 is formed a chamber 38 and an auxiliary chamber 39 is provided above the chamber 38, a piston member 40 extending from the chamber 39 through the chamber 38 to contact the valve. A conduit 41 connects the chamber 33 with the valve recess of valve 18 and similarly, a conduit 42 connects chamber 38 with valve 18. The chamber 39 is connected to a valve recess 19a of the valve 19 by a conduit 43 and this valve recess 19a is also connected to an extension 21a of conduit 21 leading from the pilot pump. A tank conduit 44 connects the valve recess of valve 17 to the tank and a conduit 45 connects valve recess 19a and valve 18 to the tank.

The valve 18 is provided with tank passages 46 and 47 which each connect with the conduit 45. The ends of this valve are vented to this line. A spring 48 acts on the valve 18 so that movement of the valve must be against this spring.

Referring now to the connection between the valve 18 and the motor 10—11, the piston rod 12 which moves in and out of the cylinder 10 is provided with a contact member 50 which is adapted to cooperate with a cam lever 51 mounted on a rod 52. At the other end of the rod 52 is a latch 53 which connects to a rod 54 at the lower end of the valve 18. A spring pressed bell crank 55 pivoted at 56 is provided with a knob 57 which cooperates with the end of the latch 53 to lock the valve 18 in certain positions as will be described. A rod 58 connects the shaft 52 with a manually operable lever 59 so that valve 18 may be manually moved. Pressure in main conduit 20 is limited by a relief valve 60 and the pressure in

conduit 21 is limited by an actuator relief valve 61 which consists of a spring backed piston 62 which bypasses the line 21 to a tank conduit 63 when a certain amount of pilot pressure has accumulated in a chamber 64.

A check valve is shown at 67 normally held in closed position by a spring 68. Conduit 69 leads from valve recess of valve 17 to valve 67. The other side of valve 67 is connected with tank conduit 44.

In the operation of the device, assuming that the piston 11 was in its extreme right position in cylinder 10, a movement of lever 59 to the forward position indicated will shift the latch 53 downward so that it will be caught beneath the knob 57 on bell crank 55 as shown in Fig. 3. Valve 18 will then be shifted to the position shown in Fig. 3 and pilot pressure may pass from conduit 21 to conduit 41 and chamber 33. This will cause an upward shifting of valve 17 and by reason of this shifting, conduit 20 from the main pressure source will be connected to conduit 25 leading to the right end of cylinder 10 (Fig. 3). At the same time conduit 24 will be connected to tank conduit 44 and piston 11 will start moving in a direction shown by the arrow in Fig. 3.

As the piston 11 reaches its extreme left position, as shown in Fig. 1, the contact member 50 will move cam 51 and valve 18 to the position shown in Fig. 1. This movement of the valve 18 will block pilot pressure from conduit 41 and connect both conduits 41 and 42 to the tank conduits 45, 46 and 47. Spring 34 may then return the valve 17 to its neutral position as shown in Fig. 1. In this position, it will be seen that pressure from the main conduit 20 may pass around valve 17 to tank conduit 44 and the pump 14 will thus be unloaded. At this time the conduit 24 is also connected to the tank conduit 44 and the conduit 25, leading from the motor, is connected to a short conduit 65 which leads to the piston end of valve 19. A spring 66 normally maintains the piston valve 19 in the position shown so that the conduit 65 is closed from conduit 20 which passes around the valve 19.

With the parts as shown in Fig. 1, it will be seen that a slight movement of the piston 11 to the right by an external force will direct liquid from cylinder 10 through the conduit 25 to the conduit 65.

Since there is no other outlet for this liquid the piston valve 19 will be shifted to the right thus opening conduit 20 to conduit 25. At the same time the pilot extension conduit 21a is connected through a recess in piston valve 19 to conduit 43 which leads to the auxiliary chamber 39 above piston 17. Pilot pressure will thus be exerted on the piston member 40 and the valve 17 will be shifted to the position shown in Fig. 2. In this position conduit 24 is blocked from the tank and connected to conduit 20 so that both of the motor ports are connected to the main pressure source. Because of the differential areas on the respective sides of the piston 11, there will be a continued movement of the piston to the right, as shown by the arrow. Consequently, it will be seen that an automatic retracting movement is effected by a slight movement in the same direction exerted on the piston rod 12. In the case of the application of the system to the rammer of a gun, the recoil movement of the gun may be used to effect the slight initiating movement and the hydraulic system will effect the continuation of the movement.

Check valve 67 operates only during the initial

movement of the retraction cycle (Fig. 2) to admit fluid from the tank to conduit 24 for filling the void created by the initial movement of piston 11 before valve 17 has been shifted in the manner just explained. It will be seen also that in case it is so desired, the retraction movement may be initiated by shifting the hand lever 59 to the retraction position thereby shifting valve 18 to the position shown in Fig. 2 and connecting conduit 21 with conduit 42 and chamber 38. Also, if immediate retraction is desired the contact member 50 may be lengthened, as shown in Fig. 2, at 50a so that the cam lever 51 will be shifted, not to its neutral position, shown in Fig. 1, but to the retraction position, as shown in Fig. 2.

What I claim is:

1. In a hydraulic system, a pressure source, a reversible motor means to be actuated by pressure from said source, means for directing pressure to said motor means to cause actuation in one direction, and means responsive to slight movement of said motor in the other direction to effect continued operation in said other direction of said motor by pressure from said source.

2. In a hydraulic system, a pressure source, a reversible motor means to be actuated by pressure from said source, a pilot operated directional control valve for directing pressure from said source to said motor to control the movement thereof, a source of pilot pressure, means for directing said pilot pressure to said pilot operated valve to shift the same to cause actuation of said motor in one direction, and additional means responsive to slight movement of said motor in the other direction to direct pilot pressure to said pilot operated valve to cause continued movement of said motor in said other direction.

3. In a hydraulic system, a pressure source, a reversible motor means to be actuated by said source comprising a piston-cylinder motor, said piston having a greater working area on one side than on the other, means for directing pressure from said source to one side of said piston to effect movement in one direction, and means responsive to slight movement of said piston in the other direction to effect continued operation in said other direction of said piston by effecting the connection of both sides thereof to pressure from said source.

4. In a hydraulic system, a main pressure source, a reversible motor means to be actuated by pressure from said source and having motor ports, a pilot operated directional control valve for directing pressure from said source having a neutral position in which pressure from said source is bypassed and working positions in which pressure is directed to respective ports of said motor to actuate said motor in opposite directions, a pilot pressure chamber at each end of said control valve, a source of pilot pressure, a pilot valve arranged to be shifted to direct pilot pressure to one or the other of said chambers to shift said control valve, means for shifting said pilot valve, and additional valve means shiftable in response to movement of said motor in one direction to effect connection through said control valve of both of said motor ports to said main pressure source.

5. In a hydraulic system, a main pressure source, a reversible motor means to be actuated by pressure from said source and having motor ports, a pilot operated directional control valve for directing pressure from said source having a neutral position in which pressure from said source

is bypassed and working positions in which pressure is directed to respective ports of said motor to actuate said motor in opposite directions, a pilot pressure chamber at each end of said control valve, a source of pilot pressure, a pilot valve arranged to be shifted to direct pilot pressure to one or the other of said chambers to shift said control valve, means for shifting said pilot valve to cause setting of said control valve to effect movement of said motor in one direction, means operably connected to said pilot valve arranged to shift said pilot valve to neutral position upon predetermined movement of said motor in said one direction, and additional valve means shiftable in response to slight movement of said motor in the other direction to connect said motor to said pressure source to cause continued movement of said motor in said other direction.

6. In a hydraulic system, a main pressure source, a reversible motor means to be actuated by pressure from said source and having motor ports, a pilot operated directional control valve for directing pressure from said source having a neutral position in which pressure from said source is bypassed and working positions in which pressure is directed to respective ports of said motor to actuate said motor in opposite directions, a pilot pressure chamber at each end of said control valve, a source of pilot pressure, a pilot valve arranged to be shifted to direct pilot pressure to one or the other of said chambers to shift said control valve, means for shifting said pilot valve, and additional valve means arranged to cooperate with said control valve and shiftable in response to slight movement of said motor in one direction to direct pilot pressure to shift said control valve to a working position whereby pressure from said main source will be directed to said motor to effect continued operation in said one direction.

7. In a hydraulic system, a main pressure source, a reversible motor means to be actuated by pressure from said source and having motor ports, a pilot operated directional control valve for directing pressure from said source having a neutral position in which pressure from said source is bypassed and working positions in which pressure is directed to respective ports of said motor to actuate said motor in opposite directions, a pilot pressure chamber at each end of said control valve, a source of pilot pressure, a pilot valve arranged to be shifted to direct pilot pressure to one or the other of said chambers to shift said control valve, means for shifting said pilot valve to cause setting of said control valve to effect movement of said motor in one direction, means operably connected to said pilot valve arranged to shift said pilot valve to neutral position upon predetermined movement of said motor in said one direction, and additional valve means arranged to cooperate with said control valve and shiftable, when said control valve is in neutral position, in response to slight movement of said motor in the other direction to direct pilot pressure to shift said control valve to a working position whereby pressure from said main source will be directed to said motor to effect continued operation in said other direction.

8. In a hydraulic system, a main pressure source, a source of pilot pressure, a reversible motor to be shifted by pressure from said main source, a main valve for controlling pressure from said source arranged to be shifted from a neutral position bypassing said main source, to working positions in which pressure is directed to

said motor, pressure chambers at each end of said valve for receiving pilot pressure to cause shifting of said valve, an auxiliary chamber at one end of said valve, means in said auxiliary chamber responsive to pilot pressure therein to cause shifting of said valve, pilot control valve means arranged to direct pressure from said pilot source to one of said pressure chambers to shift said main valve to a working position to cause movement of said motor in one direction, and additional valve means for directing pressure from said pilot source to said auxiliary chamber to cause shifting of said main valve, said additional valve means being responsive to slight movement of said motor in the other direction to effect shifting of said main valve to cause a continued movement of said motor in said other direction.

9. In a hydraulic system, a main pressure source, a source of pilot pressure, a reversible motor to be shifted by pressure from said main source, a main valve for controlling pressure from said source arranged to be shifted from a neutral position bypassing said main source, to working positions in which pressure is directed to said motor, pressure chambers at each end of said valve for receiving pilot pressure to cause shifting of said valve, an auxiliary chamber at one end of said valve, means in said auxiliary chamber responsive to pilot pressure therein to cause shifting of said valve, pilot control valve means arranged to direct pressure from said pilot source to one of said pressure chambers to shift said main valve to a working position to cause movement of said motor in one direction, and additional valve means for directing pressure from said pilot source to said auxiliary chamber to cause shifting of said main valve, said additional valve means being responsive to slight movement of said motor in the other direction, when said main valve is in neutral position, to effect transfer of pilot pressure to said auxiliary chamber whereby said main valve is shifted to a working position to cause continued movement of said motor in said other direction.

10. In a hydraulic system, a main pressure source, a source of pilot pressure, a reversible motor to be shifted by pressure from said main source, a main valve for controlling pressure from said source arranged to be shifted from a neutral position bypassing said main source, to working positions in which pressure is directed to said motor, a means for biasing said valve to its neutral position, pressure chambers at each end of said valve for receiving pilot pressure to cause shifting of said valve, an auxiliary chamber at one end of said valve, means in said auxiliary chamber responsive to pilot pressure therein to cause shifting of said valve, pilot control valve means arranged to direct pressure from said pilot source to one of said pressure chambers to shift said main valve to a working position to cause movement of said motor in one direction, and additional valve means for directing pressure from said pilot source to said auxiliary chamber to cause shifting of said main valve, said additional valve means being responsive to slight movement of said motor in the other direction to effect shifting of said main valve to cause a continued movement of said motor in said other direction.

11. In a hydraulic system, a main pressure source, a source of pilot pressure, a reversible motor to be shifted by pressure from said main source, a main valve for controlling pressure from

said source arranged to be shifted from a neutral position bypassing said main source, to working positions in which pressure is directed to said motor, pressure chambers at each end of said valve for receiving pilot pressure to cause shifting of said valve, an auxiliary chamber at one end of said valve, means in said auxiliary chamber responsive to pilot pressure therein to cause shifting of said valve, pilot control valve means arranged to direct pressure from said pilot source to one of said pressure chambers to shift said main valve to a working position to cause movement of said motor in one direction, means for causing automatic shifting of said main valve to neutral position in response to a predetermined movement of said motor, and additional valve means for directing pressure from said pilot source to said auxiliary chamber to cause shifting of said main valve, said additional valve means being responsive to slight movement of said motor in the other direction, when said main valve is in neutral position, to effect transfer of pilot pressure to said auxiliary chamber whereby said main valve is shifted to a working position to cause continued movement of said motor in said other direction.

12. In a hydraulic system, a pressure source, a reversible motor means to be actuated by pressure from said source, motor ports on said motor and conduit means for connecting said ports to said pressure source, valve means in said conduit

means shiftable to control the flow of pressure from said source to said ports and thereby control the direction and movement of said motor, a source of pilot pressure, and pilot control means adapted to control the influence of pilot pressure on said first named valve means, said pilot control means comprising a manually operated valve and an auxiliary control valve adapted to be pressure operated, said manually operated valve being adapted to control the flow of pilot pressure to and consequent shifting of said first named valve means in either direction, said auxiliary valve means being responsive to slight movement of said motor in one direction to direct pressure to said first named valve means to shift the same and cause continued operation of said motor in said direction by pressure from said source.

13. In a hydraulic system, a pressure source, a motor means comprising relatively movable parts to be actuated by pressure from said source, valve means shiftable to operating positions for directing pressure to said motor means to cause actuation thereof, and means hydraulically shiftable in response to pressure built up by relative movement of said motor parts by an external force and cooperating to cause shifting of said valve means to an operating position to effect continued relative movement of said parts by pressure from said source in the same direction as that initiated by the external force.

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